EXHIBIT 1

Biometrics History

Introduction

The term "biometrics" is derived from the Greek words "bio" (life) and "metrics" (to measure). Automated biometric systems have only become available over the last few decades, due to significant advances in the field of computer processing. Many of these new automated techniques, however, are based on ideas that were originally conceived hundreds, even thousands of years ago.

One of the oldest and most basic examples of a characteristic that is used for recognition by humans is the face. Since the beginning of civilization, humans have used faces to identify known (familiar) and unknown (unfamiliar) individuals. This simple task became increasingly more challenging as populations increased and as more convenient methods of travel introduced many new individuals into- once small communities. The concept of human-to-human recognition is also seen in behavioral-predominant biometrics such as speaker and gait recognition. Individuals use these characteristics, somewhat unconsciously, to recognize known individuals on a day-to-day basis.

Other characteristics have also been used throughout the history of civilization as a more formal means of recognition. Some examples are:

- In a cave estimated to be at least 31,000 years old, the walls are adorned with paintings believed to be created by prehistoric men who lived there. Surrounding these paintings are numerous handprints that are felt to "have...acted as an un-forgeable signature" of its originator. [1]
- There is also evidence that fingerprints were used as a person's mark as early as 500 B.C. "Babylonian business transactions are recorded in clay tablets that include fingerprints." [2]
- Joao de Barros, a Spanish explorer and writer, wrote that early Chinese merchants used fingerprints to settle business transactions. Chinese parents also used fingerprints and footprints to differentiate children from one another. [3]
- In early Egyptian history, traders were identified by their physical descriptors to differentiate between

trusted traders of known reputation and previous successful transactions, and those new to the market. [3]

By the mid-1800s, with the rapid growth of cities due to the industrial revolution and more productive farming, there was a formally recognized need to identify people. Merchants and authorities were faced with increasingly larger and more mobile populations and could no longer rely solely on their own experiences and local knowledge. Influenced by the writings of Jeremy Betham and other Utilitarian thinkers, the courts of this period began to codify concepts of justice that endure with us to this day. Most notably, justice systems sought to treat first time offenders more leniently and repeat offenders more harshly. This created a need for a formal system that recorded offenses along with measured identity traits of the offender. The first of two approaches was the Bertillon system of measuring various body dimensions, which originated in France. These measurements were written on cards that could be sorted by height, arm length or any other parameter. This field was called anthropometrics. The other approach was the formal use of fingerprints by police departments. This process emerged in South America, Asia, and Europe. By the late 1800s a method was developed to index fingerprints that provided the ability to retrieve records as Bertillon's method did but that was based on a more individualized metric - fingerprint patterns and ridges. The first such robust system for indexing fingerprints was developed in India by Azizul Haque for Edward Henry, Inspector General of Police, Bengal, India. This system, called the Henry System, and variations on it are still in use for classifying fingerprints. [4]

True biometric systems began to emerge in the latter half of the twentieth century, coinciding with the emergence of computer systems. The nascent field experienced an explosion of activity in the 1990s and began to surface in everyday applications in the early 2000s.

Condensed Timeline of Biometrics History

KEY	Iris
Biometrics	Palm
Face	Signature
Fingerprint	Speech
Hand Geometry	Vascular

Year	Description
1858	First systematic capture of hand images for identification purposes is recorded
1870	Bertillon develops anthropometrics to identify individuals
1892	Galton develops a classification system for fingerprints
1894	The Tragedy of Pudd'nhead Wilson is published
1896	Henry develops a fingerprint classification system
1903	NY State Prisons begins using fingerprints
1903	Bertillon System collapses
1936	Concept of using the iris pattern for identification is proposed
1960s	Face recognition becomes semi-automated
1960	First model of acoustic speech production is created
1963	Hughes research paper on fingerprint automation published
1965	Automated signature recognition research begins
1969	FBI pushes to make fingerprint recognition an automated process
1970s	Face Recognition takes another step towards automation
1970	Behavioral components of speech are first modeled
1974	First commercial hand geometry systems become available
1975	FBI funds development of sensors and minutiae extracting technology

Biometrics History

Year	Description
1976	First prototype system for speaker recognition is developed
1977	Patent is awarded for acquisition of dynamic signature information
1980s	NIST Speech Group is established
1985	Concept that no two irides are alike is proposed
1985	Patent for hand identification is awarded
1986	Exchange of fingerprint minutiae data standard is published
1987	Patent stating that the iris can be used for identification is awarded
1988	First semi-automated facial recognition system is deployed
1988	Eigenface technique is developed for face recognition
1991	Face detection is pioneered, making real time face recognition possible
1992	Biometric Consortium is established within US Government
1993	Development of an iris prototype unit begins
1993	FacE REcognition Technology (FERET) program is initiated
1994	First iris recognition algorithm is patented
1994	Integrated Automated Fingerprint Identification System (IAFIS) competition is held
1994	Palm System is benchmarked
1994	INSPASS is implemented
1995	Iris prototype becomes available as a commercial product
1996	Hand geometry is implemented at the Olympic Games
1996	NIST begins hosting annual speaker recognition evaluations
1997	First commercial, generic biometric interoperability standard is published
1998	FBI launches CODIS (DNA forensic database)
1999	Study on the compatibility of biometrics and machine readable travel documents is launched
1999	FBI's IAFIS major components become operational

Biometrics History

Year	Description
2000	First Face Recognition Vendor Test (FRVT 2000) is held
2000	First research paper describing the use of vascular patterns for recognition is published
2000	West Virginia University biometrics degree program is established
2001	Face recognition is used at the Super Bowl in Tampa, Florida
2002	ISO/IEC standards subcommittee on biometrics is established
2002	M1 Technical Committee on Biometrics is formed
2002	Palm Print Staff Paper is submitted to Identification Services Committee
2003	Formal US Government coordination of biometric activities begins
2003	ICAO adopts blueprint to integrate biometrics into machine readable travel documents
2003	European Biometrics Forum is established
2004	US-VISIT program becomes operational
2004	DOD implements ABIS
2004	Presidential directive calls for mandatory government-wide personal identification card for all federal employees and contractors
2004	First statewide automated palm print database is deployed in the US
2004	Face Recognition Grand Challenge begins
2005	US patent on iris recognition concept expires
2005	Iris on the Move™ is announced at Biometrics Consortium Conference

1858 - First systematic capture of hand images for identification purposes is recorded

Sir William Herschel, working for the Civil Service of India, recorded a handprint on the back of a contract for each worker to distinguish employees from others who might claim to be employees when payday arrived. This was the first recorded systematic capture of hand and finger images that were uniformly taken for identification purposes.

Peter Komarinski, Automated Fingerprint Identification Systems (need publisher info) 29.

1870 - Bertillon develops anthropometrics to identify individuals

Alphonse Bertillon developed "Bertillonage" or anthropometrics, a method of identifying individuals based on detailed records of their body measurements, physical descriptions and photographs. Repeat criminal offenders often provided different aliases when arrested. Bertillon noted that although they could change their names, they could not change certain elements of their bodies. Police authorities throughout the world used his system, until its use quickly faded when it was discovered that some people shared the same measurements. The Bertillon documents (in French) are available at http://www.biometricscatalog.org/documents/Bertillon%20Documents%20%28French%29-1.pdf.

1892 - Galton develops a classification system for fingerprints

Sir Francis Galton wrote a detailed study of fingerprints in which he presented a new classification system using prints from all ten fingers. The characteristics (minutiae) that Galton used to identify individuals are still used today. These details are often referred to as Galton's details.

"Sir Francis Galton," Galton.org <http://galton.org/>.

1894 - The Tragedy of Pudd'nhead Wilson is published

In The Tragedy of Pudd'nhead Wilson, author Mark Twain mentions the use of fingerprints for identification. In the story, a man on trial calls on the comparison of his fingerprints to those left at the crime scene to prove his innocence.

1896 - Henry develops a fingerprint classification system

Sir Edward Henry, Inspector General of the Bengal Police, was in search of a method of identification to implement concurrently or to replace anthropometrics. Henry consulted Sir Francis Galton regarding fingerprinting as a method of identifying criminals. Once the fingerprinting system was implemented, one of Henry's workers, Azizul Haque, developed a method of classifying and

storing the information so that searching could be performed easily and efficiently. Sir Henry later established the first British fingerprint files in London. The Henry Classification System, as it came to be known, was the precursor to the classification system used for many years by the Federal Bureau of Investigation (FBI) and other criminal justice organizations that perform tenprint fingerprint searches.

> "Fingerprint Centenary: Press Pack - Sir Edward Henry (1850-1931)," Metropolitan Police <http://www.met.police.uk/so/100years/henry.htm>.

1903 - NY State Prisons begin using fingerprints

"The New York Civil Service Commission established the practice of fingerprinting applicants to pre-vent them from having better qualified persons take their tests for them." This practice was adopted by the New York state prison system where fingerprints were used "for the identification of criminals in 1903. In 1904 the fingerprint system accelerated when the United States Penitentiary at Leavenworth, Kansas, and the St. Louis, Missouri, Police Department both established fingerprint bureaus. During the first quarter of the 20th century, more and more local police identification bureaus established fingerprint systems. The growing need and demand by police officials for a national repository and clearinghouse for fingerprint records led to an Act of Congress on July 1, 1921, establishing the Identification Division of the FBI."

> "Homeland Security: Fingerprint Identification Systems" 27 April 2005, GlobalSecurity.org <http://www.globalsecurity.org/security/systems/fingerprint.htm>.

1903 - Bertillon System collapses

Two men, determined later to be identical twins, were sentenced to the US Penitentiary at Leavenworth, KS, and were found to have nearly the same measurements using the Bertillon system. Although the basis of this story has been subsequently challenged, the story was used to argue that Bertillon measurements were inadequate to differentiate between these two individuals.

> "The History of Fingerprints" 26 December 2005 <http://onin.com/fp/fphistory.html>.

1936 - Concept of using the iris pattern for identification is proposed

Ophthalmologist Frank Burch proposed the concept of using iris patterns as a method to recognize an individual.

> "Individual Biometrics: Iris Scan" 5 July 05, National Center for State Courts 6 July 06 <http://ctl.ncsc.dni.us/biomet%20web/BMIris.html>.

1960s - Face recognition becomes semi-automated

The first semi-automatic face recognition system was developed by Woodrow W. Bledsoe under contract to the US Government. This system required the administrator to locate features such as eyes, ears, nose and mouth on the photographs. This system relied solely on the ability to extract useable feature points. It calculated distances and ratios to a common reference point that was compared to the reference data.

> "In Memoriam Woodrow Wilson Bledsoe," The University of Texas at Austin, Department of Computer Science <http://www.cs.utexas.edu/users/boyer/bledsoe-memorial-resolution.pdf>.

1960 - First model of acoustic speech production is created

A Swedish Professor, Gunnar Fant, published a model describing the physiological components of acoustic speech production. His findings were based on the analysis of x-rays of individuals making specified phonic sounds. These findings were used to better understand the biological components of speech, a concept crucial to speaker recognition.

> John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins, Biometrics (New York: McGraw Hill Osborne, 2003).

1963 - Hughes research paper on fingerprint automation is published

> M. Trauring, "Automatic comparison of finger ridge patterns," Report No. 190, Hughes Research Laboratories, March 1961, Rev. April 1963.

1965 - Automated signature recognition research begins

North American Aviation developed the first signature recognition system in 1965.

> A. J. Mauceri, "Feasibility Studies of Personal Identification by Signature Verification", Report no. SID 65 24 RADC TR 65 33, Space and Information System Division, North American Aviation Co., Anaheim, USA, 1965.

1969 - FBI pushes to make fingerprint recognition an automated process

In 1969, the Federal Bureau of Investigation (FBI) began its push to develop a system to automate its fingerprint identification process, which was quickly becoming overwhelming and required many man-hours. The FBI contracted the National Institute of Standards and Technology (NIST) to study the process of automating fingerprint identification. NIST identified two key challenges: (1) scanning fingerprint cards and identifying minutiae and (2) comparing and matching lists of minutiae.

> John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins, Biometrics (New York: McGraw Hill Osborne, 2003).

1970s - Face Recognition takes another step towards automation

Goldstein, Harmon, and Lesk used 21 specific subjective markers such as hair color and lip thickness to automate face recognition. The problem with both of these early solutions was that the measurements and locations were manually computed.

> A. J. Goldstein, L. D. Harmon, and A. B. Lesk, "Identification of Human Faces," Proc. IEEE, Vol. 59, No. 5, May 1971, 748-760.

1970 - Behavioral components of speech are first modeled

The original model of acoustic speech production, developed in 1960, was expanded upon by Dr. Joseph Perkell, who used motion x-rays and included the tongue and jaw. The model provided a more detailed understanding of the complex behavioral and biological components of speech.

> John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins, Biometrics (New York: McGraw Hill Osborne, 2003).

1974 - First commercial hand geometry systems become available

The first commercial hand geometry recognition systems became available in the early 1970s, arguably the first commercially available biometric device after the early deployments of fingerprinting in the late 1960s. These systems were implemented for three main purposes: physical access control; time and attendance; and personal identification.

IR Recognition Systems <http://recogsys.com/index.shtml>.

1975 - FBI funds development of sensors and minutiae extracting technology

The FBI funded the development of scanners and minutiae extracting technology, which led to the development of a prototype reader. At this point, only the minutiae were stored because of the high cost of digital storage. These early readers used capacitive techniques to collect the fingerprint characteristics. Over the next decades, NIST focused on and led developments in automatic methods of digitizing inked fingerprints and the effects of image compression on image quality, classification, extraction of minutiae, and matching. The work at NIST led to the development of the M40 algorithm, the first operational matching algorithm used at the FBI. Used to narrow the human search, this algorithm produced a significantly smaller set of images that were then provided to trained and specialized human technicians for evaluation. Developments continued to improve the available fingerprint technology.

John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins, Biometrics (New York: McGraw Hill Osborne, 2003).

Nalini Ratha and Ruud Bolle, Automatic Fingerprint Recognition Systems (Springer: New York, 2004).

James Wayman, et al, Biometric Systems Technology, Design and Performance Evaluation (London: Springer, 2005).

1976 - First prototype system for speaker recognition is developed

Texas Instruments developed a prototype speaker recognition system that was tested by the US Air Force and The MITRE Corporation.

John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins, Biometrics (New York: McGraw Hill Osborne, 2003).

W. Haberman and A. Fejfar, "Automatic ID of Personnel through Speaker and Signature Verification - System Description and Testing," May 1976 Carnahan Conference on Crime Countermeasures, University of Kentucky.

1977 - Patent is awarded for acquisition of dynamic signature information

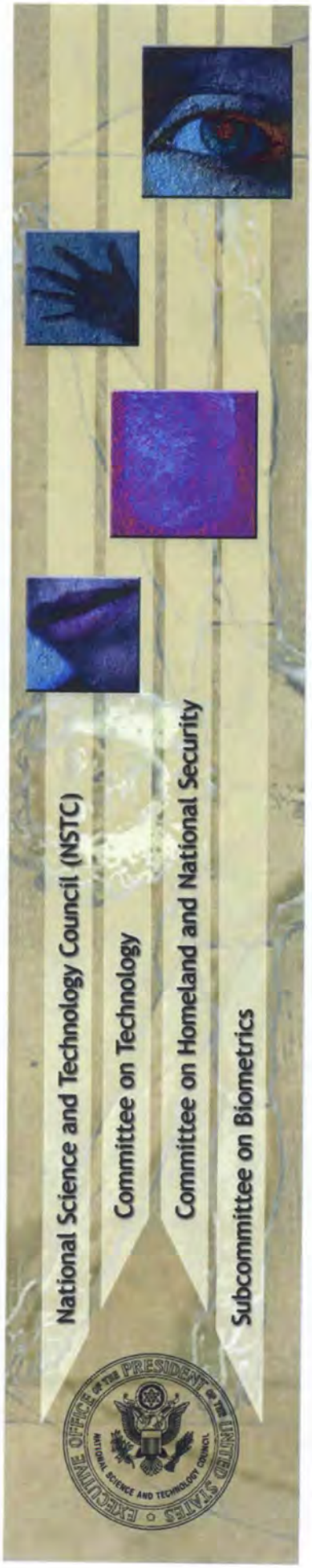
Veripen, Inc. was awarded a patent for a "Personal identification apparatus" that was able to acquire dynamic pressure information. This device allowed the digital capture of the dynamic characteristics of an individual's signature characteristics. The development of this technology led to the testing of automatic handwriting verification (performed by The MITRE Corporation) for the Electronic Systems Division of the United States Air Force.

John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins. Biometrics (New York: McGraw Hill Osborne, 2003).

1980s - NIST Speech Group is established

The National Institute of Standards and Technology (NIST) developed the NIST Speech Group to study and promote the use of speech processing techniques. Since 1996, under funding from the National Security Agency, the NIST Speech Group has hosted yearly evaluations — the NIST Speaker Recognition Evaluation Workshop — to foster the continued advancement of the speaker recognition community.

"NIST Speaker Recognition Evaluations" 25 April 2005, NIST Speech Group, 23 June 2005 <http://www.nist.gov/speech/tests/spk/index.htm>.



1985 - Concept that no two irides are alike is proposed

Drs. Leonard Flom and Aran Safir, ophthalmologists, proposed the concept that no two irides are alike.

> "Individual Biometrics: Iris Scan" 5 July 05, National Center for State Courts 6 July 06 <http://ctl.ncsc.dni.us/biomet%20web/BMIris.html>.

1985 - Patent for hand identification is awarded

The commercialization of hand geometry dates to the early 1970s with one of the first deployments at the University of Georgia in 1974. The US Army began testing hand geometry for use in banking in about 1984. These deployments predate the concept of using the geometry of a hand for identification as patented by David Sidlauskas.

> United States Patent and Trademark Office. "Patent 4,736,203: 3D hand profile identification apparatus." 5 April 1988 <http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PALL&p=1&u=/netahtml/srchnum.htm&r=1&f=G&l=50&s1=4,736,203.WKU.&OS=PN/4,736,203&RS=PN/4,736,203>.

1986 - Exchange of fingerprint minutiae data standard is published

The National Bureau of Standards (NBS) — now the National Institutes of Standards and Technology (NIST) — published, in collaboration with ANSI, a standard for the exchange of fingerprint minutiae data (ANSI/NBS-ICST 1-1986). This was the first version of the current fingerprint interchange standards used by law enforcement agencies around the world today. More information is available at

http://ai.eller.arizona.edu/COPLINK/publications/develop/develop.html.

> K. Lynch and F. Rodgers, . "Development of Integrated Criminal Justice Expert System Applications."

1986 - Patent is awarded stating that the iris can be used for identification

Drs. Leonard Flom and Aran Safir were awarded a patent for their concept that the iris could be used for identification. Dr. Flom

approached Dr. John Daugman to develop an algorithm to automate identification of the human iris.

> "Historical Timeline," Iridian Technologies <http://www.iridiantech.com/about.php?page=4>.

1988 - First semi-automated facial recognition system is deployed

In 1988, the Lakewood Division of the Los Angeles County Sheriff's Department began using composite drawings (or video images) of a suspect to conduct a database search of digitized mugshots.

> Jarvis, Angela. "Facial Recognition Systems - Are Privacy Rights of Citizens Being Eroded Wholesale?", Forensic-Evidence.com <http://www.forensic-evidence.com/site/ID/facialrecog.html>.

1988 - Eigenface technique is developed for face recognition

Kirby and Sirovich applied principle component analysis, a standard linear algebra technique, to the face recognition problem. This was a milestone because it showed that less than one hundred values were required to approximate a suitably aligned and normalized face image.

> L. Sirovich and M. Kirby. "A Low-Dimensional Procedure for the Characterization of Human Faces," J. Optical Soc. Am. A, Vol. 4, No.3, 1987: 519-524.

1991 - Face detection is pioneered, making real time face recognition possible

Turk and Pentland discovered that while using the eigenfaces techniques, the residual error could be used to detect faces in images. The result of this discovery meant that reliable real time automated face recognition was possible. They found that this was somewhat constrained by environmental factors, but the discovery caused a large spark of interest in face recognition development.

> M. A. Turk and A. P. Pentland. "Face Recognition Using Eigenfaces," Proc. IEEE, 1991: 586-591.

1992 - Biometric Consortium is established within US Government

The National Security Agency initiated the formation of the Biometric Consortium and held its first meeting in October of 1992. The Consortium was chartered in 1995 by the Security Policy Board, which was abolished in 2001.

Participation in the Consortium was originally limited to government agencies; members of private industry and academia were limited to attending in an observer capacity. The Consortium soon expanded its membership to include these communities and developed numerous working groups to initiate and/or expand efforts in testing, standards development, interoperability, and government cooperation. With the explosion of biometric activities in the early 2000s, the activities of these working groups were integrated into other organizations (such as INCITS, ISO, and the NSTC Subcommittee on Biometrics) in order to expand and accelerate their activities and impacts. The Consortium itself remains active as a key liaison and discussion forum between government, industry, and academic communities.

> "Background of the US Government's Biometric Consortium, " The Biometrics Consortium <http://www.biometrics.org/REPORTS/CTST96/>.

1993 - Development of an iris prototype unit begins

The Defense Nuclear Agency began work with IriScan, Inc. to test and deliver a prototype iris recognition unit.

> "Historical Timeline," Iridian Technologies <http://www.iridiantech.com/about.php?page=4>.

1993 - FacE REcognition Technology (FERET) program is initiated

The FacE REcogntion Technology (FERET) Evaluation was sponsored from 1993-1997 by the Defense Advanced Research Products Agency (DARPA) and the DoD Counterdrug Technology Development Program Office in an effort to encourage the development of face recognition algorithms and technology. This evaluation assessed the prototypes of face recognition systems

and propelled face recognition from its infancy to a market of commercial products. More information about FERET can be found at http://www.frvt.org/FERET/default.htm.

> P. J. Phillips, H. Moon, S. A. Rizvi and P. J. Rauss, "The FERET Evaluation Methodology for Face-Recognition Algorithms," IEEE Transactions on PAMI, Vol. 22, No. 10, 2000: 1090-1104.

1994 - First iris recognition algorithm is patented

Dr. John Daugman was awarded a patent for his iris recognition algorithms. Owned by Iridian Technologies, the successor to IriScan, Inc. — this patent is the cornerstone of most commercial iris recognition products to date.

> "Historical Timeline," Iridian Technologies <http://www.iridiantech.com/about.php?page=4>.

1994 - Integrated Automated Fingerprint Identification System (IAFIS) competition is held

The next stage in fingerprint automation occurred at the end of the Integrated Automated Fingerprint Identification System (IAFIS) competition. The competition identified and investigated three major challenges: (1) digital fingerprint acquisition, (2) local ridge characteristic extraction, and (3) ridge characteristic pattern matching. The demonstrated model systems were evaluated based on specific performance requirements. Lockheed Martin was selected to build the FBI's IAFIS.

> Maltoni, Davide, Maio, Jain, and Prabhakar, Handbook of Fingerprint Recognition (Springer: New York, 2005).

1994 - Palm System is benchmarked

The first known Automated Fingerprint Identification Systems (AFIS) system built to support palm prints is believed to have been built by a Hungarian company known as RECOWARE Ltd. In late 1994, latent experts from the United States benchmarked this palm system, RECOderm™, in Hungary and invited RECOWARE Ltd. to the 1995 International Association for Identification (IAI) conference in Costa Mesa, California. The palm and fingerprint

identification technology embedded in the RECOderm™ System was bought by Lockheed Martin Information Systems in 1997.

RECOWARE Ltd.
<http://www.recoware.hu/angdata/angmain.html>.

1994 - INSPASS is implemented

The Immigration and Naturalization Service Passenger Accelerated Service System (INSPASS) was a biometrics implementation that allowed travelers to bypass immigration lines at selected airports throughout the US until it was discontinued in late 2004. Authorized travelers received a card encoded with their hand geometry information. Rather than being processed by an Immigration Inspector, INSPASS travelers presented their tokens (cards) with the encoded information and their hands to the biometric device. Upon verification of the identity claimed, the individual could proceed to the customs gate, thus bypassing long inspection lines and speeding entry into the US. More information on the INSPASS program can be found at http://www.biometrics.org/REPORTS/INSPASS2.html.

1995 - Iris prototype becomes available as a commercial product

The joint project between the Defense Nuclear Agency and Iriscan resulted in the availability of the first commercial iris product.

"Historical Timeline," Iridian Technologies
<http://www.iridiantech.com/about.php?page=4>.

1996 - Hand geometry is implemented at the Olympic Games

A major public use of hand geometry occurred at the 1996 Atlanta Olympic Games where hand geometry systems were implemented to control and protect physical access to the Olympic Village. This was a significant accomplishment because the systems handled the enrollment of over 65,000 people. Over 1 million transactions were processed in a period of 28 days.

IR Recognition Systems
<http://recogsys.com/index.shtml>.

1996 - NIST begins hosting annual speaker recognition evaluations

Under funding from the National Security Agency, the National Institute of Standards and Technology (NIST) Speech Group began hosting yearly evaluations in 1996. The NIST Speaker Recognition Evaluation Workshop aims to foster the continued advancement of the speaker recognition community.

> "NIST Speaker Recognition Evaluations" 25 April 2005, NIST Speech Group, 23 June 2005 <http://www.nist.gov/speech/tests/spk/index.htm>.

1997 - First commercial, generic biometric interoperability standard is published

Sponsored by NSA, the Human Authentication API (HA-API) was published as the first commercial, generic biometric interoperability standard and focused on easing integration of and allowing for interchangeability and vendor independence. It was a breakthrough in biometric vendors working together to advance the industry through standardization and was the precursor to subsequent biometric standardization activities. Further information is available at http://www.biometrics.org/html/standards.html.

1998 - FBI launches CODIS (DNA forensic database)

The FBI launched Combined DNA Index System (CODIS) to digitally store, search, and retrieve DNA markers for forensic law enforcement purposes. Sequencing is a laboratory process taking between 40 minutes and several hours. More information on DNA identification can be found at the following:

> http://www.fbi.gov/hq/lab/codis/index1.htm
>
> http://www.cstl.nist.gov/div831/
>
> http://www.afip.org/Departments/oafme/dna/

1999 - Study on the compatibility of biometrics and machine readable travel documents is launched

The International Civil Aviation Organization's (ICAO) Technical Advisory Group on Machine Readable Travel Documents (TAG/MRTD) initiated a study to determine the "compatibility of currently available biometric technologies with the issuance and

inspection processes relevant to MRTDs; and quantifying these compatibilities to determine whether one or more technologies could/should be adopted as the international standard for application in MRTDs."

"Biometrics - Introduction," Machine Readable Travel Documents 2003 <http://www.icao.int/mrtd/biometrics/intro.cfm>.

1999 - FBI's IAFIS major components become operational

IAFIS, the FBI's large-scale ten-fingerprint (open-set) identification system, became operational. Prior to the development of the standards associated with this system, a fingerprint collected on one system could not be searched against fingerprints on another system. The development of this system addressed the issues associated with communication and information exchange between standalone systems as well as the introduction of a national network for electronic submittal of fingerprints to the FBI. IAFIS is used for criminal history background checks and identification of latent prints discovered at crime scenes. This system provides automated tenprint and latent search capabilities, electronic image storage of fingerprints and facial images, and electronic exchange of fingerprints and search responses.

Wayman, James, et al. Biometric Systems Technology, Design and Performance Evaluation (London: Springer, 2005).

"Integrated Automated Fingerprint Identification System: What is it?" FBI IAFIS 2 August 2005 <http://www.fbi.gov/hq/cjisd/iafis.htm>.

2000 - First Face Recognition Vendor Test (FRVT 2000) is held

Multiple US Government agencies sponsored the Face Recognition Vendor Test (FRVT) in 2000. FRVT 2000 served as the first open, large-scale technology evaluation of multiple commercially available biometric systems. Additional FRVTs have been held in 2002 and 2006, and the FRVT model has been used to perform evaluations of fingerprint (2003) and iris recognition (2006). FRVT's primary purpose is to evaluate performance on large-scale

databases. More information about each of the FRVTs can be found at http://www.frvt.org.

> "Face Recognition Vendor Test 2000," FRVT.org <http://www.frvt.org/frvt2000/>.

2000 - First research paper describing the use of vascular patterns for recognition is published

This paper describes the technology that was to become the first commercially available vascular pattern recognition system in 2000. The technology uses the subcutaneous blood vessel pattern in the back of the hands to achieve recognition.

> Sang-Kyun Im, Hyung-Man Park, Young-Woo Kim, Sang-Chan Han, Soo-Won Kim and Chul-Hee Kang, "Biometric Identification System by Extracting Hand Vein Patterns," Journal of the Korean Physical Society, Vol. 38, No. 3, March 2001: 268-272.

2000 - West Virginia University biometrics degree program is established

West Virginia University (WVU) and the FBI, in consultation with professional associations such as the International Association for Identification, established a bachelor's degree program in Biometric Systems in 2000. While many universities have long had biometrics-related courses, this is the first biometrics-based degree program. WVU encourages program participants to obtain a dual-degree in Computer Engineering and Biometric Systems as the biometric systems degree is not accredited.

> Duane Blackburn "Biometrics History," Email to West Virginia University, 10 January 2006.

2001 - Face recognition is used at the Super Bowl in Tampa, Florida

A face recognition system was installed at the Super Bowl in January 2001 in Tampa, Florida, in an attempt to identify "wanted" individuals entering the stadium. The demonstration found no "wanted" individuals but managed to misidentify as many as a dozen innocent sports fans. Subsequent media and Congressional inquiries served to introduce both biometrics and its associated privacy concerns into the consciousness of the general public.

2002 - ISO/IEC standards committee on biometrics is established

The International Organization for Standardization (ISO) established the ISO/IEC JTC1 Subcommittee 37 (JTC1/SC37) to support the standardization of generic biometric technologies. The Subcommittee develops standards to promote interoperability and data interchange between applications and systems. More information about JTC1/SC37 can be found at http://www.iso.org/.

John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins, Biometrics (New York: McGraw Hill Osborne, 2003).

2002 - M1 Technical Committee on Biometrics is formed

The M1 Technical Committee on Biometrics is the US Technical Advisory Group (TAG) to the JTC1/SC37. This technical committee reports to the InterNational Committee on Information Technology Standards (INCITS), an accredited organization of the American National Standards Institute (ANSI), which facilitates the development of standards among accredited organizations. More information about M1 can be found at http://www.ncits.org/tc_home/m1.htm. More information about INCITS can be found at http://www.incits.org/. More information about ANSI can be found at http://www.ansi.org/.

John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins, Biometrics (New York: McGraw Hill Osborne, 2003).

2002 - Palm Print Staff Paper is submitted to Identification Services Committee

In April 2002, a Staff Paper on palm print technology and Integrated Automated Fingerprint Identification System (IAFIS) palm print capabilities was submitted to the Identification Services (IS) Subcommittee, Criminal Justice Information Services Division (CJIS) Advisory Policy Board (APB). The Joint Working Group called "for strong endorsement of the planning, costing, and development of an integrated latent print capability for palms at the CJIS Division of the FBI." As a result of this endorsement and other changing business needs for law enforcement, the FBI announced the Next Generation IAFIS (NGI)

initiative. A major component of the NGI initiative is development of the requirements for and deployment of an integrated National Palm Print Service.

> NSTC Subcommittee on Biometrics, "Palm Recognition Foundation Document," December 2005.

2003 - Formal US Government coordination of biometric activities begins

The National Science & Technology Council, a US Government cabinet-level council, established a Subcommittee on Biometrics to coordinate biometrics R&D, policy, outreach, and international collaboration. More information can be found at http://www.biometricscatalog.org/NSTCSubcommittee/default.asp.

2003 - ICAO adopts blueprint to integrate biometrics into machine readable travel documents

"On May, 28 2003, The International Civil Aviation Organization (ICAO) adopted a global, harmonized blueprint for the integration of biometric identification information into passports and other Machine Readable Travel Documents (MRTDs)... Facial recognition was selected as the globally interoperable biometric for machine-assisted identity confirmation with MRTDs."

> "Biometrics - ICAO Recommendation," Machine Readable Travel Documents 2003 <http://www.icao.int/mrtd/biometrics/recommendation.cfm>.

2003 - European Biometrics Forum is established

"The European Biometrics Forum is an independent European organisation supported by the European Commission whose overall vision is to establish the European Union as the World Leader in Biometrics Excellence by addressing barriers to adoption and fragmentation in the marketplace. The forum also acts as the driving force for coordination, support and strengthening of the national bodies."

> "About the EBF," 29 October 2003, European Biometrics Forum (updated 17 January 2006) <http://www.eubiometricforum.com/index.php?option=content&task=view&id=2&Itemid=28>.

2004 - US-VISIT program becomes operational

The United States Visitor and Immigrant Status Indication Technology (US-VISIT) program is the cornerstone of the DHS visa issuance and entry/exit strategy. The US-VISIT program is a continuum of security measures that begins overseas at the Department of State's visa issuing posts, and continues through arrival to and departure from the US. Using biometrics, such as digital inkless fingerprints and digital photographs, the identity of visitors requiring a visa is now matched at each step to ensure that the person crossing the US border is the same person who received the visa. For visa-waiver travelers, the capture of biometrics first occurs at the port of entry to the US. By checking the biometrics of a traveler against its databases, US-VISIT verifies whether the traveler has previously been determined inadmissible, is a known security risk (including having outstanding wants and warrants), or has previously overstayed the terms of a visa. These entry/exit procedures address the US critical need for tighter security and its ongoing commitment to facilitate travel for the millions of legitimate visitors welcomed each year to conduct business, learn, see family, or tour the country.

> "Travel and Transportation: US-VISIT Program," Department of Homeland Security <http://www.dhs.gov/dhspublic/interapp/content_multi_image/content_multi_image_0006.xml>.

2004 - DOD implements ABIS

The Automated Biometric Identification System (ABIS) is a Department of Defense (DoD) system implemented to improve the US Government's ability to track and identify national security threats. The associated collection systems include the ability to collect, from enemy combatants, captured insurgents, and other persons of interest, ten rolled fingerprints, up to five mug shots from varying angles, voice samples (utterances), iris images, and an oral swab to collect DNA. More information on the ABIS can be found at http://www.biometrics.dod.mil/default.aspx.

2004 - Presidential directive calls for mandatory government-wide personal identification card for all federal employees and contractors

In 2004, President Bush issued Homeland Security Presidential Directive 12 (HSPD-12) for a mandatory, government-wide

personal identification card that all federal government departments and agencies will issue to their employees and contractors requiring access to Federal facilities and systems. Subsequently, Federal Information Processing Standard (FIPS) 201, Personal Identity Verification (PIV) for Federal Employees and Contractors, specifies the technical and operational requirements for the PIV system and card. NIST Special Publication 800-76 (Biometric Data Specification for Personal Identity Verification) is a companion document to FIPS 201 describing how the standard will be acquiring, formatting and storing fingerprint images and templates for collecting and formatting facial images; and specifications for biometric devices used to collect and read fingerprint images. The publication specifies that two fingerprints be stored on the card as minutia templates. Additional information is available at http://csrc.nist.gov/piv-program/index.html.

2004 - First statewide automated palm print databases are deployed in the US

In 2004, Connecticut, Rhode Island and California established statewide palm print databases that allow law enforcement agencies in each state to submit unidentified latent palm prints to be searched against each other's database of known offenders. Detailed information can be found at:

http://www.necus.com/companies/20/NECSAMCustomerAwardByCalifCenterDigitalGovt.pdf#search='first%20automated%20palm%20system

http://cogt.client.shareholder.com/ReleaseDetail.cfm?ReleaseID=145765

2004 - Face Recognition Grand Challenge begins

The Face Recognition Grand Challenge (FRGC) is a US Government-sponsored challenge problem posed to develop algorithms to improve specific identified areas of interest in face recognition. Participating researchers analyze the provided data, try to solve the problem, and then reconvene to discuss various approaches and their results – an undertaking that is driving technology improvement. Participation in this challenge demonstrates an expansive breadth of knowledge and interest in this biometric modality. More information on the FRGC can be found at http://www.frvt.org/FRGC/.

2005 - US patent for iris recognition concept expires

The broad US patent covering the basic concept of iris recognition expired in 2005, providing marketing opportunities for other companies that have developed their own algorithms for iris recognition. However, the patent on the IrisCodes® implementation of iris recognition developed by Dr. Daugman will not expire until 2011.

2005 - Iris on the Move™ is announced at Biometrics Consortium Conference

At the 2005 Biometrics Consortium conference, Sarnoff Corporation demonstrated Iris on the Move™, a culmination of research and prototype systems sponsored by the Intelligence Technology Innovation Center (ITIC), and previously by the Defense Advanced Research Projects Agency (DARPA). The system enables the collection of iris images from individuals walking through a portal.

> "Iris on the Move™ - A Superior Solution for Biometric Identification," 22 September 2005 (Press Release), Sarnoff Corporation <http://www.sarnoff.com/products_services/government_solutions/homeland_security/iris.asp>.

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[1] Janeen Renaghan, "Etched in Stone," Zoogoer, August 1997, (Smithsonian National Zoological Park, 26 January 2005).

[2] "Dermatoglyphics," Hand Analysis, International Institute of Hand Analysis, 24 January 2005.

[3] Z. McMahon, Biometrics: History, Indiana University, Indiana University Computer Science Department, 24 January 2005 <http://www.cs.indiana.edu/~zmcmahon/biometrics-history.htm>.

[4] J. L. Wayman, "Biometrics - Now and Then: The development of biometrics over the last 40 years," H. Daum (ed.) Biometrics in the Reflection of Requirements: Second BSI Symposium on Biometrics 2004. SecuMedia, Bonn, 2004.

About the National Science and Technology Council

The National Science and Technology Council (NSTC) was established by Executive Order on November 23, 1993. This Cabinet-level Council is the principal means within the executive branch to coordinate science and technology policy across the diverse entities that make up the Federal research and development enterprise. Chaired by the President, the membership of the NSTC is made up of the Vice President, the Director of the Office of Science and Technology Policy, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities, and other White House officials.

A primary objective of the NSTC is the establishment of clear national goals for Federal science and technology investments in a broad array of areas spanning virtually all the mission areas of the executive branch. The Council prepares research and development strategies that are coordinated across Federal agencies to form investment packages aimed at accomplishing multiple national goals. The work of the NSTC is organized under four primary committees; Science, Technology, Environment and Natural Resources and Homeland and National Security. Each of these committees oversees a number of sub-committees and interagency working groups focused on different aspects of science and technology and working to coordinate the various agencies across the federal government. Additional information is available at www.ostp.gov/nstc.

About the Subcommittee on Biometrics

The NSTC Subcommittee on Biometrics serves as part of the internal deliberative process of the NSTC. Reporting to and directed by the Committee on Homeland & National Security and the Committee on Technology, the Subcommittee:

- Develops and implements multi-agency investment strategies that advance biometric sciences to meet public and private needs;
- Coordinates biometrics-related activities that are of interagency importance;
- Facilitates the inclusions of privacy-protecting principles in biometric system design;

- Ensures a consistent message about biometrics and government initiatives when agencies interact with Congress, the press and the public;
- Strengthen international and public sector partnerships to foster the advancement of biometric technologies.

Additional information on the Subcommittee is available at www.biometrics.gov.

Subcommittee on Biometrics

Co-chair: Duane Blackburn (OSTP)

Co-chair: Chris Miles (DOJ)

Co-chair: Brad Wing (DHS)

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Mr. Jon Atkins (DOS)
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Dr. Michael King (IC)
Mr. Chris Miles (DOJ)
Mr. David Temoshok (GSA)
Mr. Brad Wing (DHS)
Mr. Jim Zok (DOT)

Communications ICP Team

Champion: Kimberly Weissman (DHS US-VISIT)

Members & Support Staff:

Mr. Richard Bailey (NSA Contractor)
Mr. Duane Blackburn
Mr. Jeffrey Dunn (NSA)
Ms. Valerie Lively (DHS S&T)
Mr. John Mayer-Splain (DHS US-VISIT Contractor)
Ms. Susan Sexton (FAA)
Ms. Kim Shepard (FBI Contractor)
Mr. Scott Swann (FBI)

Mr. Brad Wing (DHS US-VISIT) Mr. David Young (FAA)

Mr. Jim Zok (DOT)

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Document Source

This document, and others developed by the NSTC Subcommittee on Biometrics, can be found at www.biometrics.gov.